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SYNOPSIS OF NEARCTIC AZOTINAE (HYMENOPTERA: APHELINIDAE)

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Abstract.—Four species of the Azotinae (Hymenoptera: Aphelinidae) have been described from the Nearctic: *Ablerus clisiocampae* (Ashmead); *Azotus perspeciosus* (Girault); *Azotus americanus* (Girault), 1916 new combination; and *Azotus* ***dozieri*** new name for *Azotus americanus* Dozier, 1928. A lectotype is designated for *Azotus perspeciosus*. The original rearing record of *Ablerus clisiocampae* from the eggs of *Malacosoma americanum* (F.) (Lepidoptera: Lasiocampidae) is confirmed; the host range of this species also includes armored scale insects (Homoptera: Diaspididae). The presence of *Azotus atomon* (Walker) in the Nearctic is unsubstantiated.

Yasnosh (1976) has proposed a reclassification of the Aphelinidae (Hymenoptera: Chalcidoidea) which recognizes seven subfamilies: Aphelininae, Aphytinae, Azotinae, Calesinae, Coccophaginae, Physcinae and Prospaltellinae. The subfamily Azotinae is a small group, with only 82 described species. According to Yasnosh (1973), species are secondary parasitoids attacking Diaspididae, Coccidae, Aleurodidae (Homoptera), and are also known to emerge from the eggs of Cicadellidae (Homoptera) and Lepidoptera. Hayat (1983) has recently published a key that can be used to identify genera of the subfamily. In this paper we bring together published information on the taxonomy of Nearctic Azotinae, document nomenclatorial changes and discuss the host associations of *Ablerus clisiocampae* (Ashmead).

AZOTINAE

Azotinae Nikol'skaya 1966, in Nikol'skaya and Yasnosh 1966: 232.
Azotinae: Yasnosh, 1976: 167.

Diagnosis: antennae 7-merous; third flagellomere short, ringlike in male; clava unsegmented; pronotum entire; prepectus consisting of 2 separate sclerites; fore wings sparsely pubescent; with elongate radial vein and marginal fringe; abdominal tergites 9 and 10 separated; sternite 7 trapeziform, nearly reaching apex of abdomen; male genitalia with short, broad phallobase; basal ring present; parameres and digiti absent (Yasnosh, 1976).

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Only two genera are included in the subfamily: *Ablerus* Howard and *Azotus* Howard. These may be distinguished on the basis of (1) the shape of the apex of the stigmal vein: narrowed and linear in *Ablerus* (Fig. 3), expanded and rounded in *Azotus* (Figs. 4–7); and (2) the discal setae on the fore wing: all of uniform length in *Ablerus* (Fig. 2), with patches of distinctly longer setae in *Azotus* (Fig. 1) (see also Hayat, 1983).

Nearctic Species of *Ablerus*

Ablerus Howard, 1894: 7. Type species: *Centrodora clisiocampae* Ashmead by monotypy.

A study of the types of all species of Azotinae recorded in North America indicates that *Ablerus clisiocampae* is the only described representative of this genus in the Nearctic region. The species *americanus* and *perspeciosus,* originally described in *Ablerus,* are referred to *Azotus* (q.v).

1. *Ablerus clisiocampae* (Ashmead)

Figs. 2, 3

Centrodora clisiocampae Ashmead, 1894: 10. Type locality: Jacksonville, Florida.
Host: Egg of *Malacosoma americanum* (F.) (Lepidoptera: Lasiocampidae).
Ablerus clisiocampae: Howard, 1894: 8.
Ablerus clisiocampae: Mercet, 1912: 133.
Ablerus clisiocampae: Peck, 1951: 436.
Ablerus clisiocampae: Peck, 1963: 269.
Ablerus clisiocampae: Gordh, 1979: 899.
Ablerus clisiocampae: Yasnosh, 1978: 494.
Ablerus clisiocampae: DeSantis, 1979: 319.

Type material: USNM No. 65475 [examined]. Two females. **LECTOTYPE** (*here designated*): Female, mounted on rectangular card; labels: "Type" [printed]; "Centrodora clisiocampae Ashm." [in Ashmead's handwriting]; "Lectotype *Centrodora clisiocampae* Ashmead, desig. Darling and Johnson." Paralectotype with same pertinent data as lectotype.

There has been considerable confusion concerning the host of *Ablerus clisiocampae.* Ashmead (1894) originally described the species on the basis of specimens reared from the eggs of the eastern tent caterpillar, *Malacosoma americanum* (then classified in the genus *Clisiocampa*). L. O. Howard (1894) redescribed the parasitoid from material reared from the scurfy scale, *Chionaspis furfura* (Fitch) (Homoptera: Diaspididae). Howard added that the specific name *clisiocampae* was unfortunate because "in my opinion, the true host is Chionaspis, and not the egg stage of Clisiocampa" (p. 6).

Girault (1907) also claimed that Ashmead's record was "undoubtedly incorrect"

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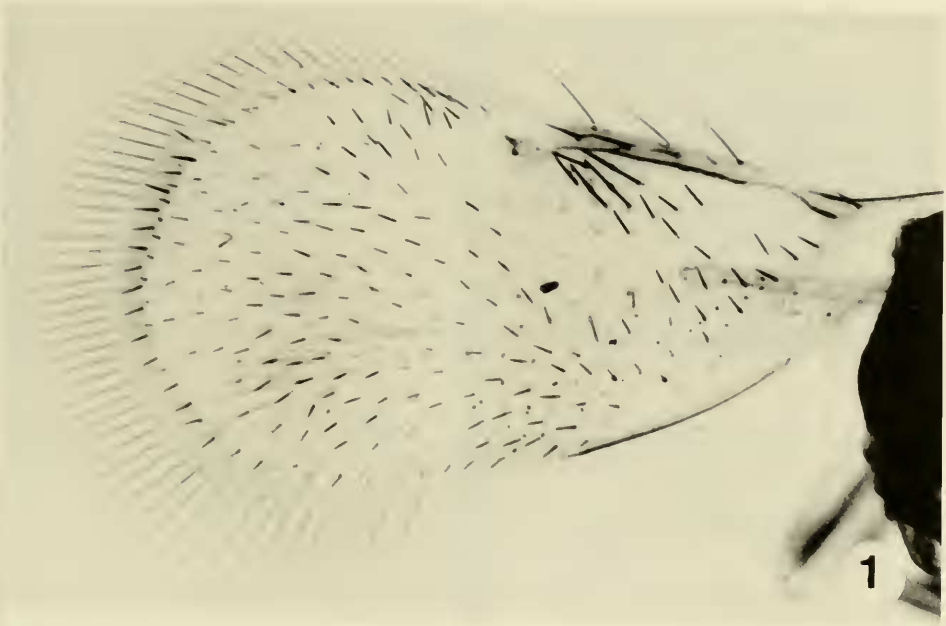
Figs. 1–3. Fore wings of Azotinae. 1, *Azotus marchali,* holotype male, showing differentiated discal setae. 2, *Ablerus clisiocampae,* female, reared from egg of *Malacosoma americanum,* showing uniform discal setae. The infuscate basal portion of the wing is found only in the female. 3, *Ablerus clisiocampae,* detail of narrowed stigmal vein.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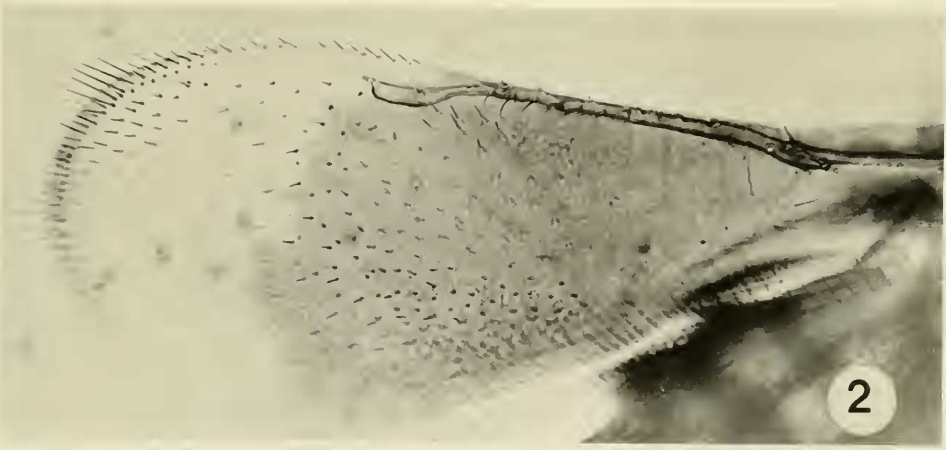
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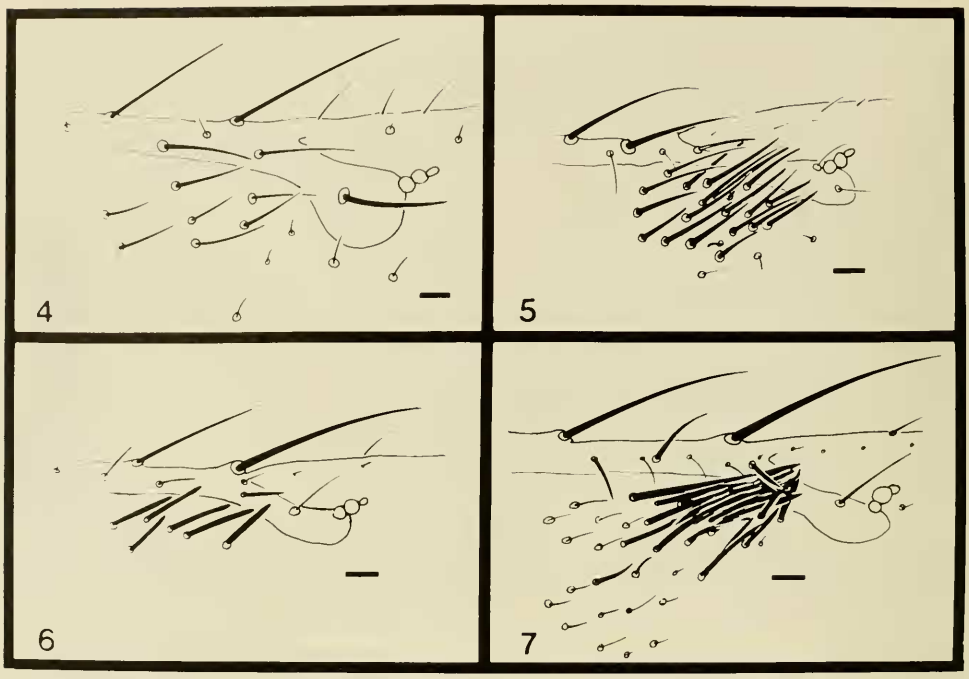

Figs. 4–7. Stigmal region of fore wings of *Azotus*. 4, *Azotus marchali*, holotype male. 5, *Azotus perspeciosus*, lectotype female. 6, *Azotus dozieri* (= *americanus* Dozier), holotype female. 7, *Azotus americanus*, holotype female. Scale line = 0.01 mm.

(p. 27). Ashmead's reported host, however, was corroborated by Williams (1916). He carefully removed *Malacosoma* egg masses from twigs in order to avoid possible contamination of the sample with scale insects. Porter (1917) also excluded scales and recovered *Ablerus* from *Malacosoma* eggs. More recent studies have reported *A. clisiocampae* in rearings of armored scales (Diaspididae) (Baker, 1933; Muma, 1959; Hughes, 1960). Peck (1951) listed both homopteran and lepidopteran hosts. Later (1963), he expressed doubt concerning the earlier *Malacosoma* records. In the most recent edition of the Catalog of Hymenoptera of America North of Mexico (Gordh, 1979) all reference to *Malacosoma* eggs as a host of *Ablerus clisiocampae* were deleted.

We have reared specimens of both sexes of *Ablerus clisiocampae* from the eggs of *Malacosoma americanum* (Darling and Johnson, 1982). We are confident that the specimens emerged from eggs and not from scale contaminants because each individual wasp was associated with a moth egg containing a larval parasitoid meconium. We have also examined Ashmead's syntypes of *Centrodora clisiocampae* (the series was not lost as reported in Peck, 1963). We have compared the types with both our reared material and specimens reared from the armored scales *Chionaspis furfura* and *Melanaspis obscura* (Comstock) (specimens from the collection of the U.S. National Museum of Natural History, Washington). We conclude that the lepidopteran and homopteran forms represent a single species, *Ablerus clisiocampae*. However, the Aphelinidae are known for the common occurrence of sibling species (see, e.g., Rosen, 1978; Rosen and DeBach, 1979).

Only detailed biological studies can determine whether this is a single polyphagous species, or two species attacking different host orders and life stages.

The wide host range for *Ablerus clisiocampae* is not unique. A comparable shift between Homoptera and insect eggs has also been reported in *Azotus* (Yasnosh, 1979). Kozlov (1972) has cited this as an example of morphotypical specialization, i.e., cases in which host range of a parasitoid is determined by general morphological similarities of potential hosts rather than, for example, specialization on a phylogenetic group. The shift of generations or individuals of *Ablerus clisiocampae* from one host order to the other has not been observed. The conclusion that they do is based upon a morphological comparison of adult wasps reared from the different hosts.

Nearctic Species of *Azotus*

Azotus Howard, 1898: 138. Type species: *Azotus marchali* Howard, by monotypy.
Dimacrocerus Brèthes, 1914: 4. Type species: *D. platensis* Brèthes by monotypy and original designation. Synonymized by Mercet (1922: 197).

[?] 1. *Azotus atomon* (Walker)

Encyrtus atomon Walker, 1847: 229. Type locality: Kollar, Austria. Host: unknown.
Azotus marchali Howard, 1898: 139, fig. 11. Type locality: uncertain. Host: *Diaspis osteaeformis* Signoret (Homoptera: Diaspididae) on pear.
Azotus pinifoliae Mercet, 1912: 141. Type locality: Madrid, Spain. Host: *Chionaspis pinifoliae* (Fitch) (Homoptera: Diaspididae) on *Pinus austriaca.*
Azotus mokrzeckii Nowicki, 1926: 108. Type locality: Bobrowa, Poland. Host: unknown.
Azotus marchali: Peck, 1951: 436.
[?]*Azotus marchali:* Peck, 1963: 271.
Azotus atomon: Ferrière, 1965: 105.
Azotus atomon: Nikol'skaya and Yasnosh, 1966: 237.
Azotus marchali: Gordh, 1979: 900.
Azotus atomon: Yasnosh, 1979: 494.

We have examined the type material of *Azotus marchali,* USNM No. 3647 (Figs. 1, 4). The material is slide mounted along with the type material of *Archenomus bicolor* Howard. Only a single specimen of *Azotus* is on the slide, the holotype male. We have indicated this specimen with an arrow (note: a specimen of *A. bicolor* is circled on the same slide).

The presence of *Azotus atomon* in North America is uncertain. There are no specimens of this species in the USNM that have been collected in North America, although the Hymenoptera Catalogs (Peck, 1951, Gordh, 1979) record it from the District of Columbia, Maryland and Virginia.

2. *Azotus perspeciosus* (Girault)

Fig. 5

Ablerus perspeciosus Girault, 1916a: 292. Type locality: Nishigahara, Japan. Host: *Pseudaulacaspis pentagona* (Targ.-Tozz.) (Homoptera: Diaspididae).
Azotus silvestrii Compere, 1926: 9, fig. 3. Type locality: Shanghai, China. Host:

Chrysomphalus aonidum (Linn.) (Homoptera: Diaspididae), on *Aucuba japonica* Thunberg (Cornaceae). Synonymized by Gahan (1942: 47).
Ablerus perspeciosus: Peck, 1951: 436.
Azotus perspeciosus: DeSantis, 1953: 74.
Azotus perspeciosus: Tachikawa, 1958: 62.
Ablerus perspeciosus: Peck, 1963: 271.
Azotus perspeciosus: Ferrière, 1965: 108, fig. 45.
Azotus perspeciosus: Nikol'skaya and Yasnosh, 1966: 236.
Ablerus perspeciosus: Gordh, 1979: 899.

The type material of *A. perspeciosus* is housed in the USNM: four females mounted on a slide, USNM No. 19930. **LECTOTYPE** (*here designated*): female, circled specimen in upper half of slide, centrally located (Fig. 5).

Specimens from Washington, D.C. [USNM] reared from *P. pentagona* and *Melanaspis obscura* (Comstock) closely agree with the type material and probably belong to this species.

3. *Azotus americanus* (Girault), New Combination
Fig. 7

Ablerus americanus Girault, 1916b: 44. Type locality: Washington, D.C. Host: *Diaspidiotus uvae* (Comstock) (Homoptera: Diaspididae) on grape.
Ablerus americanus: Peck, 1951: 435.
Ablerus americanus: Peck, 1963: 269.
Ablerus americanus: Gordh, 1979: 899.

The type material consists of a single female specimen, slide mounted, in excellent condition (USNM No. 20004). This species is referred to *Azotus* on the basis of the rounded stigmal vein and the differentiated discal setae on the fore wing (Fig. 7).

4. *Azotus dozieri* Darling and Johnson, New Name
Fig. 6

Azotus americanus Dozier, 1928: 36, fig. 1. Secondary homonym, preoccupied by *Azotus americanus* (Girault), 1916. Type locality: Newark, Delaware. Host: *Quadraspidiotus perniciosus* (Comstock) (Homoptera: Diaspididae) on *Sorbaria stellipila* (Rosaceae).
Azotus americanus: Peck, 1951: 436.
Azotus americanus: Peck, 1963: 271.
Azotus americanus: Gordh, 1979: 900.

This species is very similar to *A. atomon,* but has narrower wings. The marginal setae of the fore wing are not lengthened along the outer, lower margin as in the original description and figure. Dozier (1928) suggested that this species is a secondary parasite attacking *Prospaltella perniciosi* Tower (Aphelinidae).

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